UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 22, 2010

Mr. Mano Nazar
Executive Vice President and
Chief Nuclear Officer
Florida Power and Light Company
P.O. Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: ST. LUCIE PLANT UNIT NO. 2 - REQUEST FOR ADDITIONAL INFORMATION REGARDING GL 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS" (TAC NO. MC4711)

Dear Mr. Nazar:

By letter to the U.S. Nuclear Regulatory Commission (NRC), dated April 16, 2009, Florida Power and Light Company submitted responses to the NRC staff's January 16, 2009, request for additional information (RAI) regarding Generic Letter (GL) 2004-02, "Potential Impact of debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors" for St. Lucie Unit 2.

The NRC staff has reviewed the licensee's submittals and determined that additional information is needed to conclude that there is reasonable assurance that GL 2004-02 has been satisfactorily addressed. These RAI questions were e-mailed to you on March 4, 2010, and clarifications were discussed in a telephone call on March 25, 2010. We encourage you to move forward with preparation of the formal responses that will be the subject of a public meeting in the near future.

Should you have any questions on the issues discussed in this letter, contact me at 301-415-2020.

Sincerely,

Brenda Mozafari

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-389

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION

ST. LUCIE PLANT UNIT 2

REGARDING LICENSEE RESPONSES TO

GENERIC LETTER 2004-02

DOCKET NO. 50-389

Debris Generation/Zone of Influence (ZOI)

1. In its request for additional information (RAI) dated January 16, 2009, the U.S. Nuclear Regulatory Commission (NRC) staff requested (RAI 2) that the licensee describe how the small fines debris size category was divided into small pieces and fines for Nukon, calcium silicate, and Foamglas debris. The NRC staff reviewed your response dated April 16, 2009, and additional information is needed for Nukon and calcium silicate. Specifically, as noted in the NRC staff's safety evaluation (SE) on the Nuclear Energy Institute (NEI) Guidance Report 04-07, a two-category debris size distribution is not considered appropriate for application with analytical refinements such as computational fluid dynamics. In addition, with respect to fibrous debris, no information was provided for the NRC staff to conclude that the percentages of fines and small pieces used for the strainer head loss testing were representative of the relative quantities of these types of debris that would be predicted to reach the plant strainers. Therefore, identify the quantity of fiberglass and calcium silicate fines that would be generated during a loss-of-coolant accident (LOCA). Further evaluate the consequent effects of explicitly modeling fine fibrous and calcium silicate debris with respect to transport, head loss, and other parts of the evaluation that would be affected if fine debris transport were explicitly considered. Alternately, the licensee may choose to demonstrate that the existing evaluation would be bounding had a more refined debris size distribution consistent with the NRC staff's SE on NEI 04-07 been considered. Include a specific basis to demonstrate that the breakdown of fibrous small pieces and fines used for head loss testing is prototypical or conservative with respect to the analyzed plant condition.

Debris Transport

2. In RAI 6 in its January 16, 2009, letter, the NRC staff requested that the licensee provide contour plots of the velocity and turbulence in the containment pool, as well as for the corresponding conditions simulated in the strainer head loss test flume. The licensee provided information in response to the NRC staff's request; but the following additional information is needed:

a. Describe the extent to which the high-flow and low-flow case results were used in the design basis transport analysis and in simulating the transport of debris in the strainer test flume. In your response, clearly indicate for what purposes (e.g., simulating the failure of a low-pressure safety injection (LPSI) pump to trip) and at which times in the accident scenario the high- and low-flow cases were applied. This information is necessary because it is not clear whether proceduralized actions from the control room will lead to the prompt termination of flow from an LPSI pump that has failed to stop automatically.

b. The flow velocities in the vicinity of the strainer were unexpected, in that very low velocities appeared to be present along the approach to the strainer from which most of the debris and flow arrives, whereas very high velocities appeared to be present on the sheltered side of the strainers without an obvious physical reason. Justify that observed behavior was realistic and not an artificial result of the computational fluid dynamics (CFD) boundary condition assumed at the strainer surface.

c. Clarify the basis for considering the turbulence in the test flume to be representative of the plant containment pool.

d. Provide the length of the pathway along the trench on the more stagnant side of the strainer that was used to determine a weighted average velocity along the approach to the strainers. The fluid velocities tend to be reduced along this pathway, and, as shown in Figure 8-1, very little debris appears to transport to the strainers from this direction. Justify how a representative length of the trench on the stagnant side was used for determining an averaged flume flow.

e. Identify the elevation or depth that is represented by the contour plots provided.

3. In previous RAI 7, the NRC staff requested a description of the emergency core cooling system (ECCS) trench and how it was modeled in the CFD calculation, including the modeling of obstacles and equipment. The licensee provided a broad overview of the principles and methodology for modeling obstacles, but did not provide plant-specific details. From viewing the CFD contour plots provided by the licensee in response to RAI 6, it is not clear that any obstacles in the trench appear as either nonfluid regions or have an influence on the fluid flow in the trench. Based on discussion provided by the licensee concerning the equipment and objects located in the tank, as well as a photograph of one section of the trench, the NRC staff expects that obstacles would be present in the trench that could have a significant influence on the flow in the trench. Provide additional specific information concerning the major obstacles modeled in the trench, as well as the minimum clearances in the plant and in the CFD calculation, and how the modeled obstacles are representative of the actual obstacles in the plant.

   Although alternate flow paths would still be available to convey water to the strainers, it appears to the NRC staff that blockage caused by debris in the trench could increase the velocity along the containment pool floor and potentially result in increased transport to the strainers. Justify the assumption that this debris would be incapable of transporting into and causing blockage or flow reductions in the ECCS trench.

4. In previous RAI 9, the NRC staff requested that the licensee provide a basis for the assumptions made concerning debris erosion in the post-LOCA containment pool. Your response indicated that testing performed by Alion in the 2006-2007 timeframe formed the basis for the assumed erosion value for small pieces of fiberglass of 10-percent over a 30-day period. The NRC staff did not consider the response adequate, because of concerns whether the Alion test set up was prototypical, and because of anomalies in the test results. Provide acceptable test results that demonstrate that 10-percent erosion over a 30-day period is justified for small pieces of fiberglass in the post-LOCA containment pool and show that these test results are applicable to the St. Lucie Unit 2 Plant condition.

   In addition, the strainer head loss testing performed at Alden Laboratory used a test protocol that appears to have permitted debris settlement. Identify the flow velocities applicable during the period for which the debris settlement was credited, and provide justification for neglect of erosion of any debris that settled during the performance of the head loss test. Specific justification should be provided for the assumed eroded percentage if the velocities in the test flume during the transport portion of the test were in excess of the incipient tumbling velocity at which erosion testing was performed.

5. In previous RAI 10, the NRC staff requested a description of the modeling of drainage from the containment sprays and a basis for assuming a uniform spray drainage model. The licensee's response did not provide a basis to conclude that the effect of non-uniform spray drainage (e.g., drainage from the refueling canal, floor drains, spillage from solid floors, etc.) can be neglected, either in the vicinity of the strainers (for the purpose of strainer testing that credits debris settlement), or throughout the containment building (in the analytical debris transport analysis). In particular, it was not clear that streams of drainage water would realistically be broken up into dispersed droplets by obstacles prior to reaching the containment pool surface, or that the location of specific concentrated drainage sources is not significant. Provide additional basis to justify the assumed spray drainage model adequately represents the plant condition and identify any significant sources of non-uniform drainage that could affect either the analytical transport calculation or the flow modeling in the strainer test flume.

6. In previous RAI 12, the NRC staff requested a technical basis to support the assumption that 23 percent of the calcium silicate debris settles in the containment pool and a description of the sizes assumed for the settled debris. Provide additional justification to address the two remaining items identified below regarding this RAI: (1) the licensee's response appeared to credit inactive volumes with capturing washed-down debris, even though these inactive regions would typically fill prior to the majority of debris washing down from upper containment (which may be addressed by the licensee in general when responding to new RAI 7, below), and (2) Was provided no information concerning the size distribution of the calcium silicate assumed to settle in the containment pool. This information is needed to confirm that the debris transport metrics used by the licensee to determine transport were applicable to the assumed debris size category and whether the potential for erosion has been considered.

7. In previous RAI 13, the NRC staff requested further information regarding the assumed locations of debris at the onset of the switchover to recirculation. The licensee provided discussions applicable to small fines and large pieces of debris. The NRC staff had two remaining issues regarding the licensee's response. The first is that the licensee's discussion of small fines debris assumed that a significant fraction of the small fines debris blown to upper containment would be washed down prior to the filling of inactive volumes in the containment pool and would be captured in these inactive volumes. This assumption is not consistent with the position stated in the SE on NEI 04-07 or the NRC staff's understanding regarding the sequence of post-LOCA events, since inactive pools typically fill more quickly than the time necessary to wash most debris from upper containment into the post-LOCA pool. The second issue is that the licensee assumed that 92 percent of small fines debris remaining in lower containment in active pools would remain inside the bioshield wall during pool fill. The licensee's approach of assuming that the percentage of small fines remaining inside the bioshield after pool fill is equal to the percentage of the total sump fluid volume that is located inside the bioshield appears to lack a physical basis. High pool velocities and directed flow toward the annulus would likely result in more debris transport to the annulus than this volume ratio approach would predict, and would likely result in an increase in debris transport to the strainers. Provide additional justification to support this assumption or demonstrate that the transport results for small pieces remain conservative.

<u>Head Loss and Vortexing</u>

8. Justify that the debris added to the strainer performance testing was prepared to adequately or conservatively represent the debris predicted to arrive at the strainer by the plant transport evaluation. Address in your response the following points:

   a. Clearly define the fibrous debris size categories considered in the transport evaluation.

   b. Provide the amount of each fibrous debris size predicted to arrive at the strainer by the transport calculation.

   c. Provide the amounts of each debris type and size added to the test. Provide justification for how the surrogate categories realistically or conservatively represented the debris predicted to reach the strainer by the transport evaluation. Provide information that quantifies the sizes of the fibrous debris surrogates.

   d. Provide information that justifies that the fine fibrous debris added to the head loss testing was prepared in a manner such that the added debris was as suspendable as it would be in the plant.

   e. State whether fine fibrous debris was removed from the small fibrous debris prior to addition to the test flume. If the fines were removed, provide information that justifies that this action resulted in prototypical or conservative head loss testing parameters.

f. Justify that significant agglomeration of debris did not occur during its addition to the test flume.

g. Justify that the flow rates and turbulence present in the test flume were representative or conservative with respect to those expected in the plant for the purposes of debris transport to the strainer.

9. The licensee's response stated that, following the addition of the full debris load to the test, there was open strainer area remaining on the strainer and that, therefore, a thin bed had not formed. Based on a review of the head loss test graph provided in response to previous RAI 24, it appeared that head loss was still increasing when chemical debris was added to the test. Justify that the test methodology, particularly the timing of the chemical debris addition, did not affect the test results nonconservatively by nonprototypically preventing the transport of debris to the strainer.

10. The licensee's response to previous RAI 27 stated that the licensee performed a viscosity correction to the test results from a nonchemical debris bed. Based on the post-test photographs that show strainer area that is covered only by chemical debris and no fibrous debris, it is not clear that a viscosity correction should be made to the nonchemical result. Justify the use of the viscosity correction to the nonchemical result or recalculate the nonchemical head loss at higher temperatures using an appropriate methodology.

11. Provide an evaluation of potential deaeration as the sump fluid passes through the debris bed. The results of the deaeration evaluation should be compared against the guidance contained in Appendix A of Regulatory Guide 1.82, Rev. 3 to ensure that the limits in the guidance are not exceeded. If deaeration is predicted to occur at limits within the guidance, adjust net positive suction head (NPSH) required as described in the Regulatory Guide and verify NPSH margin.

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Sincerely,

/RA/

Brenda L. Mozafari, Senior Project Manager
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